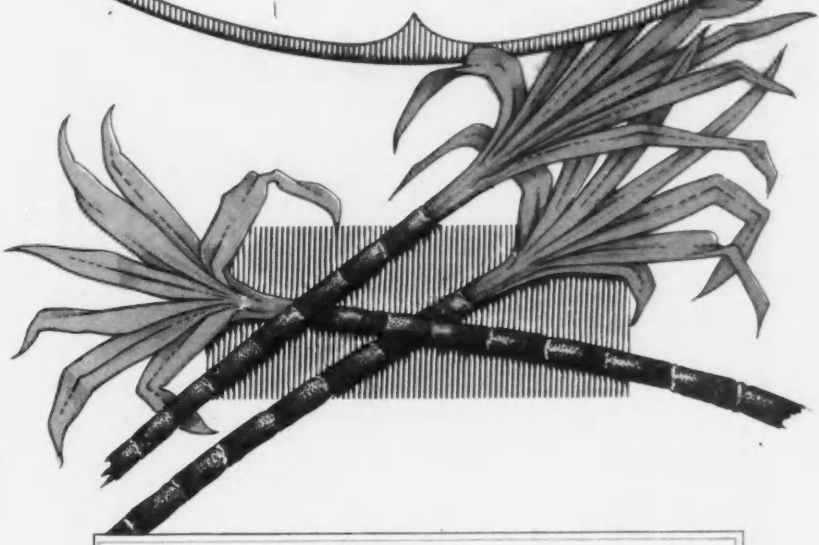
DEPARTMENT OF AGRICULTURE AND STOCK.

The CANE GROWERS' QUARTERLY BULLETIN

ISSUED BY
BUREAU OF SUGAR EXPERIMENT STATIONS
BRISBANE, QUEENSLAND.



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INTENSIVE CANE CULTURE.

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ISSUED BY DIRECTION OF THE
HON. F. W. BULCOCK, MINISTER
FOR AGRICULTURE AND STOCK

1 OCTOBER, 1937

DAVID WHYTE, GOVERNMENT PRINTER, BRISBANE

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The
Cane Growers' Quarterly
—Bulletin—

VOL. V | 1 OCTOBER, 1937 | No. 2

Review of 1937 Report of Director of Sugar Experiment Stations.

The 1937 Annual Report of the Bureau of Sugar Experiment Stations was tabled in Parliament on the 9th September, 1937. For the convenience of cane growers, the following abstracts have been prepared; these present the major features of the Report, and particularly those of interest to the cane farmer.

1936 CROP.

The 1936 cane crop amounted to 5,171,516 tons of cane, from which were manufactured 744,261 tons of sugar. Both figures are all-time records for Queensland, as is also the value of the crop (£11,337,580). The average tons of cane required to make 1 ton of 94 n.t. sugar was 6·94. The average yield of cane per acre was 21·1 tons, giving an average sugar yield of 3·04 tons; this is the first occasion that the sugar yield has exceeded 3 tons, and is in marked contrast to the customary yields experienced at the beginning of the century, when 1½ tons per acre was regarded as normal. The area harvested was 245,152 acres.

ESTIMATES, 1937 CROP.

The estimated yield for the 1937 crop is 4,880,000 tons of cane, from which it is expected 707,000 tons of sugar will be manufactured. Although there has been a slight reduction on preliminary estimates for the Central and Southern districts, certain of the northern mills have increased their early forecasts.

MOLASSES DISPOSAL.

In view of the record production of molasses in 1936, it is of interest to study the manner in which this was disposed of—

	Gallons.
Sold to distilleries	6,086,864
Burnt as fuel	6,354,841
Used or sold for feed	4,351,822
Sold or used for other purposes ..	397,080
Used as manure	3,211,423
Run to waste	560,326
Total	20,962,356

These figures provide rather a striking contrast with those of previous years. While the molasses production was a record total, substantial increases were shown in respect to all items, excepting the amount run to waste, which was reduced from 1,214,678 to 560,326 gallons. Drought conditions in the dairying districts of Southern Queensland were doubtless responsible for an increased utilization of molasses as a stockfeed, while that proportion used as manure showed an increase of nearly 700,000 gallons over 1935. Distilleries also accounted for 1,400,000 gallons in excess of the 1935 value. It must, therefore, be concluded that the industry is finding good use for increasing quantities of this by-product. Doubtless there remains the problem of the large quantity burnt as fuel when fibre in cane values are low.

1936 SUGAR VALUES.

The following were the respective prices realised for the 1936 crop:—

	£	*s.*	*d.*
Average Australian price	24	2	0
Average No. 1 Pool price	17	1	4
Average *All Sugar*	15	4	8

ECONOMIC REVIEW.

The outstanding event of the past year was the International Sugar Conference convened in London in April, 1937, under the auspices of the League of Nations. This Conference marked a logical attempt on the part of the sugar-producing world to impose such control on sugar production as was necessary to introduce greater stability in the industry. For many years, excess stocks of raw sugar have existed, and the prices at which it was necessary to clear these were substantially below production costs for practically every sugar-producing country.

Australia was represented at this Conference by a delegation led by the Federal Treasurer (Mr. R. G. Casey), very ably supported by the Honourable the Premier of Queensland (Mr. W. Forgan Smith) as alternative delegate to the Commonwealth appointees. In all, representatives of twenty-three countries participated in the deliberations, which occupied a period of more than three weeks.

An agreement was finally drawn up, which proved acceptable to practically all countries. This agreement aims at "maintaining the free market by preventing its restriction through a disproportionate expansion of national production or of the quantities supplied under preferential arrangements. It also aims at encouraging an extension of the free market by promoting increased consumption." It established a scheme of export quotas in accordance with the immediate requirements of the free market, while providing for any expansion which may result from increased future demands. The agreement will operate for five years, as from 1st September, 1937. The quotas as fixed were "not so restricted as to arouse any fears that supplies will be inadequate to meet demand, or that prices will be forced up unduly to the prejudice of consumers."

The agreement was signed in London on the 6th May, 1937. It is a comprehensive document which defines the operations of the plan,

sets out the objectives of those countries (including Australia) not exporting to the free market, and defines the quotas of those supplying this market. An International Sugar Council was established, with headquarters in London, to administer the agreement.

So far as Australia is concerned, an export quota of 400,000 tons per annum was granted. This sugar will be marketed within the British Empire. A proviso is added that in the event of any consumption increase in those parts of the British Empire which are at present importers, the British Dominions and Colonies and the United Kingdom beet producers shall obtain a share in this increase, proportionate to that which they have at present.

From the point of view of Australian producers, the result must be regarded with satisfaction. It has been repeatedly emphasised that producers in this country have never aimed at the production of sugar for export. The present situation is one which has been brought about by a number of factors, which encouraged production to such an extent that it rapidly overtook the consumption rate. The most important consideration, from our point of view, is that we should have an assured market for our exportable surplus, and, further, that any scheme which could so regulate production that the world's sugar price might be brought to a level nearer to that of the production cost is definitely to be endorsed. The ruling price on the free market over the past few years was such that virtually no country could produce sugar profitably for this purpose.

It is pleasing to record that in recent months the market quotation is substantially in advance of that obtaining a year ago, and the net value of the Australian export sugar would have revealed a very important improvement were it not for the concomitant increase in overseas freight rates, which largely offsets any benefits hitherto acquired.

It is obvious that the success attained by the new Agreement will depend very largely on the measure of increase which is obtained in world sugar consumption. The Conference directed special attention to this factor, notably in respect of those countries in which *per capita* consumption is low, because the retail price has been inflated due to the excessive fiscal charges imposed. Statistical data of recent years have demonstrated a very encouraging increase in world consumption, which has resulted in a substantial reduction in sugar stocks. Should this be sustained, there is every probability that further advances will be made in market values; however, one would not be so bold as to predict an early increase to a point which would stimulate a desire for increased production in this country.

Arising from the discussion which took place during the course of the Conference, and quite apart from the Agreement altogether, was a matter of perhaps even greater significance to Australian producers. That was the decision of the British Government to grant the Dominions a continuance for five years of the existing rebates of duty, and an undertaking that eighteen months' notice would be given of any decision to terminate the preference. Even if the International Agreement should break down, this assurance provides a measure of stability which previously did not exist.

During the 1936 season Queensland produced a sugar crop far in excess of any hitherto recorded. Practically 425,000 tons of sugar were exported, and the average net price of *all* sugar was £15 4s. 8d. per ton. It is freely suggested that this crop was highly abnormal in magnitude due in a large measure to the particularly favourable weather conditions experienced in all areas from Mackay north. Doubtless this explanation is true, insofar as it applies to the 1936 crop; but one cannot overlook the fact that improved efficiency in field and mill and the wider adoption of intensive cultivation methods in recent years have been responsible for a sharp upward trend in average production. Our records show the following five-year period averages for yields of sugar per acre:—

Period.	Sugar per Acre. Tons.
1919-1923	2·01
1924-1928	2·37
1929-1933	2·51
1934-1936 (3 years)	2·84

It would, therefore, appear probable, irrespective of season, that the Queensland average will very soon fluctuate about 3 tons of sugar per acre, and even then it will not have reached its limit. With the progressive development of irrigation resources, the writer confidently anticipates that a yield of 3·5 tons per acre will be obtained in the course of a few years; and even on the present harvestable acreage, a crop in excess of 800,000 tons of sugar could readily be achieved.

The industry is therefore still faced with the problem of looking to the future in order to avoid, if possible, any further complications which might arise from natural and logical causes such as those suggested.

NORTHERN EXPERIMENT STATION, MERINGA.

Further progress has been made in the clearing of land on this Station. Until such times as the area has been brought under the plough, little can be attempted in field trial work, with the exception of preliminary varietal trials, to assist in the selection of seedling, which will ultimately be tested more rigorously in farm trials.

Of the seedlings which have now reached this stage, Q.2 has been added to the lists of varieties issued by the Bureau in respect of the areas from Mossman to Tully. Certain later propagations are now under observation on selected farms, while some of them are actually undergoing yield trials to determine whether their promise warrants their being released as approved canes.

CENTRAL EXPERIMENT STATION, MACKAY.

This Station is rapidly coming into a normal rotation, and the volume of field trial work is being increased. The first experimental blocks were harvested during 1936: these included a qualitative fertility trial and a varietal trial, including three of the most promising seedlings raised to date at Mackay.

The results from the fertility trial indicate the customary nitrogen deficiency common to the Mackay lands, and this is particularly evident in the results from sulphate of ammonia which are now evident in the first ratoon crop.

Two of the new seedlings tried outyielded Q.813, which was employed as the standard of comparison. Unfortunately, these canes are too susceptible to downy mildew disease to warrant their release for general planting. The third seedling equalled Q.813 in cane yield, while it gave a higher C.C.S., and the indications are that the variety may possess value on the richer soils of the area. It is now being tried out under these conditions in the Proserpine and Mackay districts.

The Rotational Grazing Block has already been described in earlier issues of the Bulletin. The sheep are doing well, and so far have been free from serious parasites, despite the wet nature of the land during the wet season. A further 2-acre block will be planted to cane this year, while the balance of the area is being graded and drained, for pasture experimental work while the land is out of cane. Much is expected of this project, in that it may indicate how the old Mackay lands may be profitably employed, while at the same time, their fertility may be restored to a higher level.

A small area of lucerne has also been planted, and a selection of imported legumes (including soybeans) are being tried under local conditions.

The horse ration which was adopted at this Station two years ago, and which is based on chop, molasses and protein meal, is again reported on. The animals are thriving on this diet, and it would appear to have established very definitely (*a*) the value of molasses when fed at the rate of 8 lb. per horse per day, and (*b*) the fallacy of the oft-expressed idea that working animals must be fed grain. Recently, the linseed meal concentrate formerly employed has been substituted by peanut meal, which offers greater feed value at a cheaper price. The horses have taken kindly to this material, and have suffered no ill-effects from the change over.

Farm trials in the area are again coming to the fore, and this year several varietal experiments—P.O.J. 213 *v* Co.290 have been set out on lands where the "thin" canes are grown.

A Field Day was held at the Station in late June; a full report of the function appears elsewhere in this issue.

SOUTHERN EXPERIMENT STATION, BUNDABERG.

The crop results at the Bundaberg Station for the 1936 season constitute records for the period during which the farm has been under the control of the Bureau. Some 557 tons of cane were harvested, at an average of 27·8 tons per acre. While this accomplishment is due in part to the adoption of irrigation on a small scale, the improvement over past years is largely the result of growing the superior disease-resistant canes which have now come into favour in these parts.

Most of the farm buildings were renovated during the past year, while a new machinery room, stables and store, and seedling hothouse have provided facilities which are greatly appreciated, and which will make for higher efficiency in operation.

The most interesting trials which have been conducted at this Station in recent times are the varietal experiments, in which new gum-resistant varieties are tested against the old standards. In most of these trials, Co.290 has demonstrated its ability to produce very satisfactory yields under a variety of conditions: under irrigation, both P.O.J. 2725 and 2878 have proven their suitability.

An interesting feature of some of the newer varieties is the rather poor strike often experienced, particularly at certain seasons. A trial was, therefore, laid down to determine the influence of "double-planting" (i.e., laying two setts side by side), as against the standard "single sett" method. The yield increase for the former was 2·3 tons of cane per acre on the plant crop: the ratoons could be expected to show still further gains as a result of the better stand obtained.

The cultural trials, have, as usual, demonstrated no gain in yield, due to either shallow or deep cultivation, provided weeds were not allowed to get out of hand in the "non-cultivated" plots. It is very doubtful whether any benefits follow from cultivation operations on the red volcanic soil, except as a weed control measure.

A very successful Field Day was held at the Station on the 10th June last: the function was fully described in the July issue of the Bulletin.

SEEDLING PROPAGATION.

The season just past proved to be a poor one for arrowing, and a number of standard varieties produced no tassels at all. Some thirty crosses were made and seed sown at Meringa, Mackay, and Bundaberg. Four seedlings were released for propagation for farm trials, three from Meringa and one from Mackay. Q.10 has shown some promise in the preliminary farm trials in the far North, and will be further tested this year; Q.2 has been planted to an appreciable area, and it remains to be seen how it will ratoon under general farming conditions.

ENTOMOLOGICAL INVESTIGATIONS.

A considerable amount of variety testing, particularly that of rind hardness, has been carried out in connection with beetle borer control, as the utilization of harder rinded and top rot resistant varieties appears a promising method of control. It is in this respect, particularly, that Q.2 and Q.10 have shown some promise. The beetle borer situation shows an improvement this year over last, but the question of field sanitation requires much more attention. The practice of low topping early in the season followed by the raking of unburned debris into rows offers a very favourable field for the intensive breeding of large borer populations ready to infest the young ratoon crops. Any debris left after burning the trash should be reburned or scattered so that it will dry out rapidly.

Grub damage was somewhat intensified by the excessively dry weather which prevailed uniformly during the autumn, and permitted grubs to do their maximum degree of damage. This was especially so in the case of the Mackay district. An area of about 564 acres was fumigated with success in the far North; in the Central districts crop returns do not as a rule permit the expense of fumigation, and the chief line of attack must always be the growth of strong rooting varieties.

The Giant American Toad has now been distributed to all districts, and is increasing in numbers, but naturally it will be some years before its utility as a controlling agent of cane pests can be assessed. Already, however, we are receiving favourable reports of its work in reducing insect pests in vegetable gardens.

Conditions during the wet season in the Mackay area were such as to favour the development of lowland wireworms in such country as was not adequately drained. It must again be emphasised that to control these wireworms the necessary drainage must be put in prior to the wet season, and not just prior to planting.

DISEASE INVESTIGATIONS.

The droughty conditions which prevailed in the Southern district have also reduced the amount of disease, but in any case gumming has virtually become a thing of the past, although still causing concern in the Mulgrave area. Top rot was little in evidence, while dry conditions also reduced the spread of Fiji and downy mildew diseases.

A long known disease, rind disease, has reappeared to some extent in over-mature standover crops in the Southern district. Some damage to crops was caused during the dry spring of 1936, and it is anticipated that there will be more damage during the current season when excessively dry conditions will induce overmaturity on a wide scale; indeed, some tests indicated that standover P.O.J. 2878 in Bundaberg was in some cases over mature early in June.

A considerable amount of work has been initiated in the direction of finding more suitable legumes for fodder and green manure crops in the hope that it may later become practicable to follow a system of crop rotation. Undoubtedly the practice of growing cane on the same land year after year is having a deleterious effect on our cane soils. A long range experiment on crop rotation has been initiated at the Bundaberg Station, and will be continued for some years. This trial will also be used for the purpose of testing out new leguminous crops which might be useful either as green manure crops or as fodder crops.

VARIETY INTRODUCTIONS.

Six varieties were introduced from overseas during the year, five coming from India and one from New Guinea. The canes from India comprised Co.364, a cross between P.O.J. 2725 and Badila, and four "wild" canes for breeding purposes. The New Guinea cane was one forwarded on behalf of the United States Department of Agriculture, and is being grown in quarantine for that institution.

Instructor in Cane Culture, Johnstone-Tully District.

Growers in the Johnstone-Tully district are notified that Mr. H. G. Knust has taken up duties as Instructor in Cane Culture. Mr. Knust's address is P.O. Box 630, Innisfail, and his telephone is Innisfail 271.

Lupins for a Winter Cover Crop.

By N. J. King.

MANY canegrowers practise spring planting in South Queensland and thus have a fallow period from the time of harvesting until August or September of the following year. The usual practice is to grow a Poona pea crop in the summer, and then leave the land in bare fallow until required for planting. Several growers have attempted to grow a winter crop of field peas as well as the Poona pea crop, but the poor weight of material obtained has been disappointing. The Manager of Windermere Plantation (Mr. C. Colquhoun) this year planted some blocks with the New Zealand Blue Lupin in an endeavour to find a suitable winter crop. So far as is known this is the first planting of this seed on Queensland cane country. A trial planting was also made at the Bundaberg Experiment Station. The success of the crop has now been proved, and for those who prefer a second green crop to a bare fallow there is little doubt that the lupins will be successful. The illustration is

Fig. 12.—Crop of winter grown New Zealand Blue Lupin, Bundaberg Station.

from the block on the Experiment Station. The photograph was taken in the heaviest corner of the block, and a section was cut down here prior to turning under to obtain the weight of green material. This amounted to nineteen and one quarter tons per acre. The crop was ploughed under when in flower. It is a very succulent crop, easy to plough, and is in no way fibrous. The disc cuts through it easily. Owing to its succulence it will probably rot quickly. It should be mentioned that as the seed was planted in early June when the land was very dry the sprays were put on the block for a germination. Another spraying was given when the crop was about nine inches high.

A reasonable argument against the growing of a winter green crop is that should a dry spring be experienced there will be no moisture left in the soil after the crop has rotted. Planting would then have to be

postponed. This note on lupins, however, is not a recommendation to grow winter crops, but a suggestion of crop worth trying for those farmers who favour this method of agriculture.

We have had no experience of the value of the blue lupin as a fodder crop in Queensland, but a strain of this plant is now being grown extensively as a fodder crop in Western Australia. It has proved itself particularly well adapted to light sandy soils under the conditions of winter rainfall obtaining in that State. It has proved particularly suitable for sheep grazing; the sheep will eat the young plants but will not eat the further growth until the seed is ripe, when they eat the seeds with relish.

Effect of Winds on Cane Growth.

The red soil area of the Bundaberg district is characterised by strong winds which blow freely throughout the year. The effect of strong winds on cane growth has been recorded in other cane countries, and the results are marked at the Bundaberg Experiment Station, particularly on the south-eastern corner which is devoted to cane seedlings.

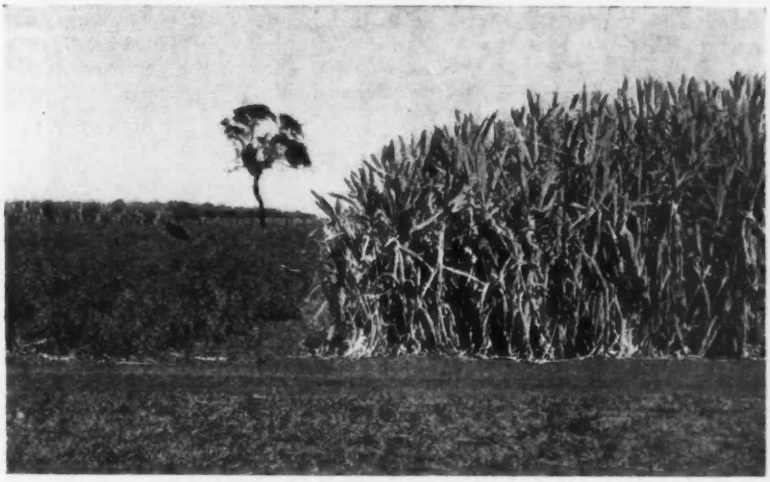

Fig. 13.—Depressed growth of outer rows of cane due to action of wind.

To overcome this trouble, a giant privet windbreak has been planted along the southern border of the Station, and is making excellent growth. It is hoped that the protection it will afford in a year or two will minimise the effects of south-easterly winds, which are the most serious.

The accompanying photograph (Fig. 13) shows very strikingly the effect of wind-blowing on the outer rows of cane of one of the Station blocks.

In passing, attention is directed to the crop of lupins on the left hand side of the illustration: this crop is described in detail in this issue (p. 44).

N.J.K.

First Steps in Irrigation Practice.

By H. W. Kerr.

INTRODUCTION.

IT is pleasing to record the sustained interest in the value of irrigation practice, as an aid to reduced production costs; this is evident in most cane areas of Queensland, with the exception of the humid belt from Tully to Babinda. Doubtless, irrigation is also the greatest single force capable of conferring stability and certainty in those areas where rainfall deficiency and distribution are the major factors in limiting acreage yields. The best example of what may be achieved by wide-scale irrigation is the Lower Burdekin area. During recent years great strides have been made in the more economical application of water and the judicious use of appropriate manures; the result has been to raise the average sugar yield per acre, over the three mill areas, to almost 5 tons of sugar per acre.

In response to numerous requests, the following notes have been prepared to serve as a guide to those farmers who, with limited funds, are desirous of searching for and developing water resources chiefly through their personal efforts, so as to minimise costs of investigations and installation. It is hoped that the relevant data provided may prove useful, though it should be stressed that these notes are necessarily general in character, and specific advice should be requested where any special features are involved.

WATER SUPPLY.

The first consideration is, of course, the availability of adequate, good-quality water. This may be obtained from either open streams or subterranean sources. In point of fact, there is essentially no difference between these seemingly widely separated sources. In each case a stream of water is involved; whereas the former is flowing in an existing "natural" water course, the subterranean stream actually follows a pre-existing course which has since become overlaid by sediments or other deposits so that its existence is no longer obvious, but along which underground streams are still able to flow. The major difference is, of course, that careful search is required to locate the latter; but it is rather significant that Queensland practice demonstrates a generally greater degree of reliability and permanence than can be claimed for open streams, notably in the drier areas of the State.

The location of underground water is a subject for controversy which revolves around the claims advanced in support of some occult power, alleged to be possessed by certain individuals, in detecting the existence of subterranean water—so-called "divining." The writer has no desire to become involved in any discussion on this topic, and doubtless nothing that might be advanced for or against would influence farmers in their attitude towards the diviner and his work. Suffice it to say that the location of probable sites at which water-bearing strata will be encountered is largely a matter of "hit and miss" methods. Where any extensive borings have been made in an area, it is possible to formulate general principles which will indicate whether the site selected offers prospects of success. The only sure method of testing any probable site is by boring. In soft strata, the use of a posthole

digger, and later, the sand pump, may enable a bore to be driven in a fairly simple and rapid manner. But where compact rock strata are encountered, the use of a boring outfit is necessary. Naturally the cost of boring will be governed by the nature of the strata and the depth at which water is encountered.

QUALITY OF WATER.

One of the first considerations, when a water supply is located, is to determine the quality of the water. It is always desirable to have a test made by a competent analyst, whether the water be drawn from an open stream or an underground supply. For this purpose, a representative sample of about a pint should be transferred to a clean bottle, and despatched to the nearest Sugar Experiment Station, or the Head Office of the Bureau, where an analysis will be made and an opinion given free of charge to all canegrowers. With subterranean supplies, the sample should be taken after pumping for a time to assure that the sample is truly typical of the supply and is not the result of surface seepage.

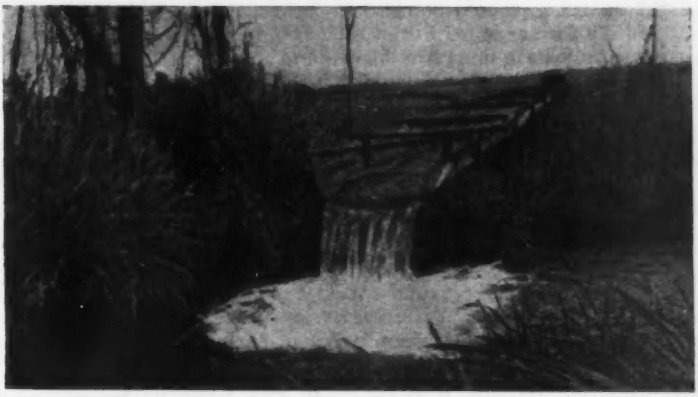

Fig. 14.—Delivery of water from flume to main ditch.

Many natural waters are too salty for irrigation purposes, while others contain harmful amounts of substances such as carbonate of soda, which act as "poisons" to crops. This simple precaution of chemical test is always worthwhile, and might save much worthless expenditure on plant and installation. The limiting concentrations of undesirable salts cannot be formulated without reference to the soil type on which the water will be used, and to the presence or absence of other compounds in the water, which may act as correctives.

TESTING CAPACITY OF SUPPLY.

It is next important to determine the capacity of the available supply. Where an open stream is to be drawn on, this is a relatively simple matter. For large streams, records are generally available, from gaugings, and these will indicate the capacity of the river or creek with the necessary degree of accuracy. It is well recognised that open streams vary in flow, being usually at a minimum in the spring and

early summer months. As it is at this season of the year that the greatest demands are made by the cane crops, the farmer should assure himself that the flow (or flow plus possible storage) is capable of supplying the full demands of the plant which he proposes to install. This is especially important with creeks of limited capacity. For such streams it may be necessary to arrange for a measuring weir to be installed, and careful and systematic flow records kept. To provide some idea of the flow required to supply the needs of centrifugal pumps of varying size, the following table is presented as a useful guide:—

Diameter of Pump. Inches.	Capacity per hour. Gallons.
3	9,000
4	16,000
5	24,000
6	33,000
7	45,000

Where the minimum flow does not permit of the desired pump size, the possibilities of damming the stream to provide night storage for daylight pumping, should be carefully investigated. It should be noted that, before a farmer is permitted to draw on open streams for irrigation purposes, application must first be made to the Department of Irrigation and Water Supply, which will advise him of the formalities to be complied with.

As a guide to the number of acres which might be watered satisfactorily with a given supply, it is safe to assume that this will be equal to the number of thousands of gallons which the pump will deliver per hour. Thus, for a 7 inch pump delivering 45,000 gallons per hour, an area of 45 acres may be watered adequately, when the pump is operated for ten hours per day, approximately 100 days per year.

The testing of underground supplies is not so simple. Some indication may be gained by a pumping test on a bore which has been driven into the water-bearing stratum. When boring, it is customary to operate the auger, sand pump, etc., inside a steel casing somewhat larger in cross sectional area than the tool which is employed. By applying weights or force to the casing, it is driven downwards as the soil or sand is removed from within. Successive lengths of casing are attached to enable it to extend to the water-bearing stratum; for preference, the casing should be lowered to the *bottom* of this layer. For the pumping test, a "spear" attached to a suitable suction pipe is then lowered within the casing, and attached to a pump. The spear consists of a cylinder of gauze which serves to admit the water while excluding the sand. Modern spears are now manufactured as variations of the earlier type, but they perform essentially the same task with greater or less efficiency.

The nature of the test pumping unit is a matter for consideration. A centrifugal or other form of suction pump cannot be operated unless located at not more than 25 feet above the water level; the level will, of course, also be lowered during the progress of the trial.

Naturally, the capacity of a single bore may not provide a true reflex of the full capacity of the water beds. A number of factors enter to complicate the problem. If the water-bearing stratum, or "drift" as it is called, is of very coarse sand or gravel, it will offer little

resistance to the free passage of water, and it may be possible to draw a large supply from a single bore. On the other hand, a fine sand drift may yield water at a relatively slow rate, yet with a series of spears, each suitably located, and jointed to one central suction pipe, it may supply over 100,000 gallons of water per hour. These questions require careful study and test in order that the true capabilities of the site may be gauged. Of course, expert advice is very helpful and necessary in reaching a reliable conclusion in these matters.

Fig. 15.—Main or feeder ditch.

Fig. 16.—Furrow irrigation from main ditch.

SELECTION AND INSTALLATION OF PUMPING UNIT.

Having established the existence of an ample and accessible water supply, the next considerations are what it will cost to deliver water to the field, and what will be the most economical unit to install for pumping; the latter question involves (*a*) cost of installation, and (*b*) operating and maintenance cost.

The cost of pumping will be directly related to the height to which the water must be raised. Thus it will require four times the power to raise a given quantity of water 100 feet, as it will to raise it 25 feet. To determine the total "head," as it is called, one must determine the difference in height between the water in the drift, *when the pump is operating,* and the point of emergence of the water from the delivery pipe. In addition, it is necessary to make allowance for the friction loss due to the passage of water through the spears and pipe line. It is customary to provide a suction and delivery pipe about 1 inch greater in diameter than the intake and outlet of the pump respectively, to avoid any serious loss from the lastnamed cause. However, if water

must be raised a considerable height through heavy gauge piping, the increased diameter may add appreciably to the installation cost. The friction loss at the spear will be governed by the type of drift.

When the total head against which the pump must operate is known, it is possible to calculate the approximate engine power necessary to take care of the desired volume of water. This figure will naturally be governed by the efficiency of the pump. Though the modern centrifugal pump has been developed to a high state of efficiency, it is most important that the speed at which it is operated be carefully checked to ensure the maximum pumping efficiency. That is to say, there is definite speed at which the pump will deliver water at a minimum cost per gallon; for speeds above or below this figure, the *actual* water delivery will be raised or lowered, but at the same time the cost per gallon will be invariably increased. The best speed will also depend upon the pumping head, and the guidance of a reputable irrigation supply firm should be sought in the selection of the most suitable unit for a given job.

Fig. 17.—Illustrating tube method of delivery of water from feeder ditch to furrows. The flow of water may be controlled by adjusting the level of the galvanised iron tubes.

Wherever practicable, it is desirable to install a horizontal centrifugal pump, operated by belt drive from the engine. As was indicated earlier, the pump must not be more than 25 feet above the level of the water, or it will not draw its supply. For preference, the pump should be placed as close as possible to the water bed. Where the water-bearing drift is, say, 30 feet below the land surface, a pit or well may be scouped or dug to a suitable depth, and the pump installed therein. The engine may then be placed at normal land level.

For deep supplies, the vertical spindle centrifugal pump becomes necessary. As the excessively long shafting required for this purpose

demands adequate bearings, to assure true running, the heavy channel iron supporting frame for such a layout adds considerably to the installation cost. However, it is essential for efficient working with deep supplies of underground water.

A so-called "one-stage" centrifugal pump is satisfactory provided the total pumping head does not exceed, say, 100 feet. With greater heads, the efficiency of the pump falls off at such a rapid rate that a two- or three-stage unit should be employed. Naturally, this will increase the installation cost to some extent, but it makes for reduced costs of operation.

To provide some indication of the manner in which the pumping costs per million gallons of water will vary with variation in the pumping head, the following examples are given. In each case a pump supplying 50,000 gallons of water is stipulated:—

Overall Head.	Nature of Pump.	Pump Speed.	Engine Power Required.
Feet.		Revolutions per Minute.	Horse Power.
25	Single stage-low head	1,230	11·5 net.
50	Single stage-low head	1,480	19·0 net.
100	Single stage-high head	1,550	38·0 net.
200	Two stage-high head	1,550	76·0 net.

In making these calculations, allowance has *not* been made for the power transmission loss, which is often very considerable with an inefficient belt drive. Direct coupling of the pump to engine eliminates this loss, but is seldom practicable.

The selection of a suitable power unit offers considerable scope. Four types are commonly employed—(*a*) steam, (*b*) suction gas, (*c*) internal combustion oil engine, or (*d*) electric motor. The older units were almost all steam operated; then came the era of the suction gas engine, where an abundance of suitable firewood was available. More recently petrol and kerosene internal combustion engines were introduced, while the latest types are almost exclusively so-called "diesel" engines, which operate on crude oil. The last-named type has practically superseded all others. Occasionally, electrical power is employed, either from general service mains or from a central installation employing, say, crude oil or coal to generate electricity, which may be used to operate at will any or all of a number of pumps suitably located over the area to be watered.

It is reasonable to dismiss consideration of steam units in laying down a modern plant. Suction gas may warrant attention in particularly favourable circumstances, but, like steam, it demands the continuous attendance of an operator, which adds substantially to pumping costs.

The internal combustion oil engine—and notably the crude oil type—does not suffer from this handicap. While it must not be assumed that an engine of this class may be allowed to run unattended, it is true that intermittent supervision only is demanded, and the operator may devote attention to other duties as well. At the present cost of crude oil, and with the high efficiency of this type of engine, a maximum fuel cost of ½d. per horse power per hour may be assumed.

The power of the engine required must also be considered carefully. While it is obviously unwise to attempt to overload the engine, it is not good business to over-capitalise the plant by installing an unduly high-powered unit. Expert advice is most helpful in arriving at a satisfactory decision; however, the following formula will provide the farmer with a fair estimate of power of a suitable engine, making due allowance for transmission and friction losses and overload margin:—

$$\text{H.P. required} = \frac{\text{Total head (suction, delivery and friction), in feet} \times \text{gallons of water per hour.}}{100{,}000}$$

That is, multiply the vertical distance in feet, from the water-level to the highest point of the delivery pipe, plus an allowance for friction losses, by the estimated volume of water the pump will deliver hourly, and divided by 100,000.

Fig. 18.—An irrigation spear.

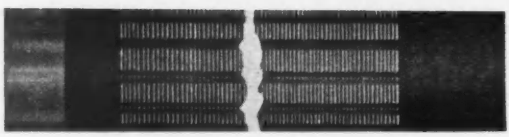

Fig. 19.—New type of slotted spear.

It has already been observed that the pump speed is very important, and care must be taken to select suitably sized belt pulleys for engine and pump to give the desired revolutions.

Where water is drawn from an open supply, it is only necessary to provide that the suction opening has access to an adequate depth of sand-free water, and to assure that it is not drawing air. Where an

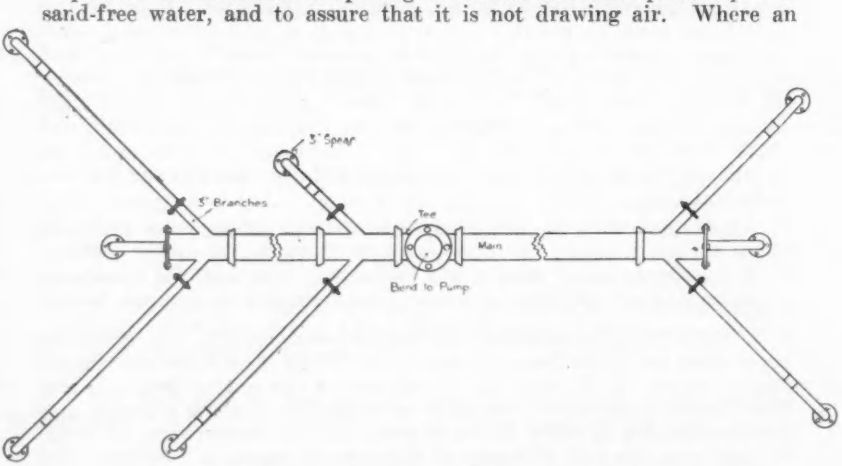

Fig. 20.—Typical arrangement of a spear system.

underground drift is tapped, care must be taken to ensure complete separation of all sand or gravel from the water entering the pump. The selection of suitable parts for the spear system is therefore of importance. It is found that, where the drift is of medium or fine sand, the rate of passage of water to the spear is relatively slow, and it is then desirable to connect a number of 3-inch spears to a common suction pump. With coarse sand or gravelly drift, fewer large-sized spears (6 inches) are a distinct advantage; they are simpler to install and also less costly and troublesome to maintain. The accompanying illustration indicates the manner in which the spear system is spread out, to assure that a volume of drift is tapped, adequate for the full water requirements of the pump. Though there is nothing particularly difficult in installing a spear system, there are certain well recognised principles which must be observed for successful operation, and the grower would be well advised to seek expert guidance in this regard.

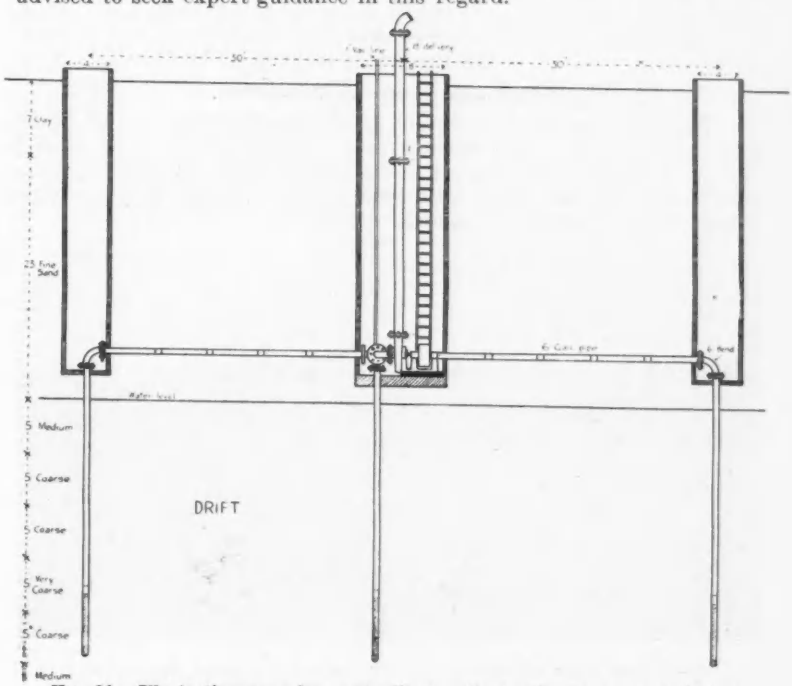

Fig. 21.—Illustrating use of concrete lined wells for deep spear installations.

Wells are sometimes employed to provide the source of supply to the pump. In general, these do not have a high capacity unless combined with a spear system radiating outwards from the bottom of the well. However, it is frequently possible to obtain at least a 4-inch pump supply from open water in this way; such a unit is working successfully at the Mackay Sugar Experiment Station. The dry, upper portion of this well is lined with corrugated galvanised iron, in the form of a cylinder; when the water-bearing stratum was encountered, a brick lining was employed, and this was built up as the water-bearing sand was removed and the brick ring subsided. During the sinking of a well of this nature it is necessary to pump out the water at the same rate as

that at which it enters; a centrifugal pump, the speed of which can be varied as required is desirable in this connection.

ECONOMICS OF PUMPING.

The grower will naturally be highly interested in determining what expenditure it is economical to incur in delivering the water to his crop. Over-all costs (allowing fully for interest and redemption on the installation and maintenance and running costs) vary very considerably. In certain favoured areas water may be obtained for a total cost as low as 22s. 6d. per million gallons. In general, it will be considerably higher.

The farmer may take it as a safe guide that, provided he is able to finance the layout, water costs not exceeding £5 per million gallons will prove highly economical, particularly in the drier areas of the State.

Drainage for Wireworms.

The following notes are issued in respect of the low-land wireworm pest, particularly in the Mackay area. Other species of wireworms may be found in well drained and elevated lands but the damage to cane caused by them is of little consequence, although they are often blamed for bad strikes due to other causes.

Fig. 22.—A poor stand of cane in a badly drained depression due to the eyes of setts having been destroyed by wireworms.

As was forecast in the Quarterly Bulletin for July, 1936, damage to cane plantings by wireworms in the Mackay district was both widespread and severe during the spring of 1936. In very many cases the warning issued against early planting went unheeded, with the result that many blocks had to be heavily supplied or replanted. At the Mackay Experiment Station Field Day and again in the Quarterly Bulletin for July of this year it was pointed out that the wet season had been such as to favour the development of wireworms and a warning was again issued against early plantings where drainage was inadequate.

In addition, on each occasion, the necessity for drainage *prior to the wet season* was emphasised. As we have repeatedly pointed out, in its young stages the young wireworm requires extremely wet soil conditions in order to survive, although it can later withstand very dry conditions. It is to avoid providing this extremely wet condition during the rainy season that adequate drainage is necessary.

Severe losses have been caused by wireworms during the current spring and are still being experienced. As is usual at such times many theories and "cures" are advanced, but exhaustive experimenting and practical experience in the Mackay district has proved that the only method of controlling the lowland wireworm pest of cane is to have the land thoroughly drained in readiness for the wet season prior to planting.

Consequently, all farmers who have fields which are to be planted in 1938, and which are liable to wireworm attack, should immediately set to work and provide the necessary drainage. It is realised, of course, that some fields, or parts of fields, cannot be drained satisfactorily and in such cases, following a heavy wet season, planting should be delayed until late September at the earliest.

Advice as to drainage systems or information regarding farms where the wireworm damage has been eliminated by proper drainage, will be given on application to the Entomologist, Sugar Experiment Station, Mackay. Good drainage is not only valuable from the point of view of wireworm control—it is good sound agricultural practice whether wireworms are present or not.

W.A.McD.

Fiji Diseased Cane should be Dug Out Immediately.

Attention has repeatedly been drawn to the potential importance of Fiji disease in Southern Queensland, especially following the widespread plantings of P.O.J. 2878. The disease is spread from diseased to healthy plants by the sugar-cane leaf-hopper, an insect which is much reduced in numbers at present but which will rapidly increase towards the end of the year. It is consequently imperative that any diseased stools should be discovered and dug out *now* while the chances of spread by the leaf-hopper are not great. Delay is dangerous; the necessary inspections of young plant and ratoon cane should be commenced immediately and continued till all blocks have been inspected.

The present dry season will have done a great deal to assist in control of this disease, firstly by causing the death of a greater proportion of the diseased stools in the field and, secondly, by reducing leaf-hopper populations below normal. Therefore now is the time to assist nature and make a thorough job of the clean up.

P.O.J. 213 and Co. 290 are both highly resistant, but the valuable standover P.O.J. 2875 requires close attention in all areas of Southern Queensland.

A.F.B.

Field Day, Mackay Sugar Experiment Station, 25th June, 1937.

THE first Field Day since the transfer of the Station to its present site was held at the Mackay Experiment Station on Friday, June 25th. The attendance of 150 farmers was not as large as had been anticipated but none could cavil at the cause of the small attendance since, following the long-awaited rain, farmers were very busy rushing on their planting programme. In the unavoidable absence of the Honourable the Minister for Agriculture, a welcome was extended to farmers on behalf of the Advisory Board and Staff of the Bureau by Mr. Ben Courtice, Cane Growers' Representative on the Advisory Board. Following the delivery of technical addresses by Dr. H. W. Kerr (Director) and Mr. A. F. Bell (Assistant Director), and short addresses by Messrs. George Johnson (Chairman, Queensland Cane Growers' Council) and Chas. McKinley (Chairman, Mackay District Executive), the gathering was taken on a tour of inspection of the Station under the leadership of Mr. D. L. McBryde (Chemist-in-Charge). In order to facilitate the inspection each visitor was provided with a typed summary, setting out the location, objects and results of the various experiments being conducted. Considerable interest was evinced in the long-range rotational and grazing experiment being conducted with a small flock of sheep of Merino-Corriedale cross, and in an exhibit of the chief cane pests of the district.

In his opening remarks Dr. Kerr referred to the inadequacy of the site of the old Station, and expressed his belief that the new site would enable the Station now to meet all the demands made of it. It would be difficult to find an area better situated in respect of accessibility and general suitability for all classes of experimental work, including irrigation, drainage, seedling raising and implement trials. He paid a tribute to the generosity of the Australian Estates Company, who had made a very substantial gift of land at the time of the purchase of the block. Dr. Kerr apologised for the absence of the Minister for Agriculture, who had been keenly desirous of attending the function, and asked Mr. Ben Courtice to address the gathering.

Mr. Courtice pointed out that a Field Day was one of the few opportunities the growers had of making personal contact with the officers of the Bureau, and for that reason the occasion was of great value. He gave an assurance that the work of the Bureau was progressing and proceeding more satisfactorily now than for many years past. The broad system of reorganisation had tended towards greater efficiency. The new site for the Mackay Experiment Station was ideal, and reflected great credit on those responsible for the change over, and he was sure the results would prove the wisdom of the move. In the past the Bureau had been subjected to a great deal of criticism, some of which was neither constructive nor fair. Now, however, it was felt that the growers of Queensland were directly responsible for the Bureau. The industry had been threatened in Bundaberg, and the Bureau had introduced new canes, and changed ruin into prosperity. Growers must realise that the scientific side of the industry must continue to advance in order to meet the demands of economic conditions. The staff of the Bureau had now been built up and equipped to deal with all phases of activity, with the result that the scientific side, in both field and mill,

was receiving greater attention than in the past. This made it possible to look forward to the future with a great deal of hope.

Mr. Courtice said he trusted growers would not ask for conditions and services which were not altogether reasonable. If the Board had agreed to every request for additional staff and reshuffling it would now find itself burdened with a staff of impossible size and negligible balance. It was necessary for the growers to interest themselves in the work of the Bureau and to co-operate in every way possible in order that the best results might be achieved. He regretted that the season was not as favourable as it might have been, but added that Mackay was very fortunate compared with prospects in Bundaberg.

Following addresses by Dr. Kerr and Mr. Bell, Mr. Chas. McKinley expressed the gratification of the farmers of the district at the transfer of the Experiment Station to its present site, particularly as the greater area of land would permit of experiments being carried out on a farm scale. Mr. George Johnson complimented the Bureau on the standard of the work being carried out. He expected that the Advisory Board would prove of very great assistance in furthering the work of the Bureau, and he was particularly pleased to see Mr. Courtice, the Cane-growers' representative on the Board, present that day. At the instance of Mr. Johnson, a vote of thanks to Mr. Courtice and the staff of the Bureau was carried with acclamation.

ADDRESS OF DR. H. W. KERR, DIRECTOR.

In my introductory remarks I have already extended a welcome to our visitors, whom we are pleased to have with us this afternoon, and I would again cordially invite you to make full use of the brief time at your disposal to make yourself fully acquainted with our work.

You have been provided with a programme, which includes a plan of the Station, and which should enable you to follow the layout of the several experimental blocks and the nature of the trials which are under way. I propose now to simplify these notes, and to set out briefly the policy which is being pursued.

The area of the Station is approximately 70 acres; it extends as a narrow strip from 10 to 12 chains wide, and almost ¾ mile in length. These dimensions provide blocks of ideal proportions for our work. The highest portion of the farm is in the neighbourhood of the laboratory and other buildings, and this area is devoted to the propagation of new seedling canes, from true seed collected from fuzz produced at our Fresh-water cane-breeding plots, near Cairns. This project is one of the most important functions of the Station, and each year some 8,000 to 10,000 new varieties are produced in this way. We fully appreciate the necessity for canes of superior yielding capacity, combined with high C.C.S. and resistance to the major cane diseases of the area. In the past we have relied upon importations from overseas to maintain the supply, but in the future we must do more to help ourselves. At the present time you will see seedling canes which were planted as tiny seeds in 1936; selections from previous plantings which have been planted for further trial; while three of our most promising canes to date will be seen in a varietal trial, in which Q.813 is the standard of comparison. One or two of these may be planted out on farms for further trial this Spring, though the particular individual which gave the best yield in the plant crop is rather highly susceptible to downy mildew disease.

For seedling propagation we must have access to a moderate supply of irrigation water, and in this respect we are fortunate in possessing a well, sunk in drift sand, which has no difficulty in supplying a 4-inch. centrifugal pump; the water is of excellent quality. This supply also paves the way for irrigation experimental work, which we consider is of the greatest importance to the future welfare of the Mackay district. This will be referred to in more detail later.

Just in front of the laboratory is a block of Q. 813 ratoons, which represents a fertility trial similar to those set out on the farms of the area, to tell us something of the plant food deficiencies of the land. In the plant crop very little benefit was recorded, as the land had not been cropped to cane for some years. But the first ratoon crop shows unmistakable evidence of the benefits from sulphate of ammonia—a usual experience on the old lands of this area, which indicates also the value to be obtained from green manuring in the Mackay soils, provided a suitable legume crop is planted.

A few of our blocks were planted as non-experimental cane when we first commenced operations, but as these are ploughed out, they will be devoted to suitable trials.

Our Block C, situated at about the centre of the cultivated area, is a field of particular interest. It is almost uniformly poorly drained, low land, on which more photographs have been taken to illustrate wireworm damage to crops than any similar area in Mackay. The field is 16 acres in extent, and has been subdivided, for experimental purposes, into eight plots. We plan to utilize this area permanently for several purposes—(1) As an area in which the benefits from adequate drainage may be studied; this is a most important problem in many of the Mackay soils. (2) As a suitable area on which to test the value of long fallowing, as a means of rejuvenating the poorer lands of the district, when combined with recognised valuable agricultural practices, such as moderate fertilization, green manuring, and the seeding of pastures carrying legumes. And (3), to demonstrate what may be done to derive profit from the land while it is pasture, and thus provide the means of supplementing the farmer's income from canegrowing.

We believe that the adoption of such a policy in the Mackay district, where more good land is available for cultivation than is required for cane production, will show the farmers of the area the best means of escape from the present difficulties in which they find themselves, due to the production of excess sugar. Long fallowing as outlined will build up the fertility of the soil, and intensify the production of cane per acre. In our trials we will grow only plant and first ratoon crops, followed by a fallow of five or six years. Only one-third of the area will therefore be under cane at any time. On poor acid soils of this character, legumes which are tolerant to those conditions will be a necessity. At the present time we are undertaking considerable experimental work in this regard. You will have the opportunity of inspecting a small field in which have been planted a selection of legume species not well known in the area. These include several varieties of the Soybean—a crop which has come into considerable favour in the United States in recent years, due to its high fodder value, as well as to the richness of its seed as a grain concentrate; Berseem clover, from Egypt and Lespedeza or Japanese clover are legumes which have been grown successfully under adverse conditions in other parts of the world, and

we will determine their value for Mackay conditions. We hope to determine, also, why lucerne—the King of Fodders—is not grown more liberally in this district. The small block to the right of the Station entrance has just been seeded to this crop, after careful inoculation of the seed with a culture of the root nodule organisms appropriate to this species. This block will, of course, be irrigated.

The production of improved fodder crops, and the combination of grazing with fallowing on such areas, should provide us with the alternative means we desire of reducing our surplus cane production, while enabling the land to be put to profitable use while out of cane. In our case, we have taken up the question of sheep grazing and cross-bred lamb production. Block C now carries twenty-five Merino-Corriedale ewes and a Romney Marsh ram, and visitors may judge for themselves the condition of the animals in this environment. To date we have seen no signs of harmful parasites or diseases, while the present condition of the pasture (mostly panicum grass) on which they are running suggests that the 8-acre block could well support considerably more than the present twenty-six animals. With improved pastures—notably when legumes have been introduced—even better results should follow. The production of wool and lambs, for which there exists a ready market, certainly offers a much more attractive proposition at the present time than does the growing of excess cane; and while the many cane restriction schemes which have been advocated may serve to improve the average price per ton of cane produced, they certainly reduce the gross income of the district as a whole, if the land thus thrown idle is not put to some profitable use.

Finally, I would take this opportunity of stressing the need for the widest development of our irrigation resources. It has frequently been stated that the Mackay area is devoid of those wonderful underground supplies of water which have meant so much to the Burdekin delta; and while this is generally true, experiences of the past few years suggest that the possibilities in this regard are not negligible, as is demonstrated by the unsuspected supply we have discovered under our own Station. Doubtless many other growers have convenient access to similar supplies, and we would urge their fullest exploitation. Irrigation practice intensifies yields per acre, assures the full benefits from manures, and enables crop production to be brought under almost complete control, with reduction in costs per ton of cane. As indicating the value of irrigation in the production of alternative crops, also, I might cite our experience in the Bundaberg area, where we are able to produce, at a very low cost, 15 tons of lucerne hay per acre annually, thus paving the way for the intensification of a stock fattening scheme, from which I feel the future of Coastal Queensland cannot be dissociated.

I have said sufficient in respect to our general agricultural work and policy. In disease and pest control we are also attempting to serve the grower, and Mr. Bell, Assistant Director and Pathologist, will address you on these subjects. Our entomologist, Mr. McDougall, is making a special study of the problem of rats in canefields, and he will later display specimens of rodents caught in this area, and which form the subject of his studies of life histories and control measures. We have also brought specimens of well-grown giant toads from North Queensland, as being of interest to growers in this district. Several thousands of young toads

have been liberated in various parts of the Mackay area in recent months, so that similar big fellows should shortly be a common member of our varied domesticated animals; their economic value in pest control remains to be proven.

ADDRESS OF MR. ARTHUR F. BELL, ASSISTANT DIRECTOR.

It is proposed to-day to submit, on behalf of the Division of Entomology and Pathology, a brief survey of the present status of diseases and pests in the Mackay district. I am pleased to be able to say that as far as the disease situation is concerned the survey can justifiably be very brief; the Mackay district is very fortunate inasmuch as the aggregate annual losses from cane diseases is relatively quite small. It is greatly to be hoped that this desirable state of affairs will be preserved, and in this respect we would urge the desirability of all farmers strictly observing the quarantine regulations and loyally abstaining from introducing cuttings of varieties from other districts.

Some years ago, it may be recalled, leaf-scald was introduced into the district and spread to a number of farms; the Bureau made available the full-time services of an officer to make inspections and supervise the control of this disease, and we are pleased to be able to report that it is now some years since it has been observed. Red rot, which is mainly a disease of over-ripe cane, was prevalent in the district some years ago, particularly in the Plane Creek area, but, due to the improvement of the harvesting conditions, and some change of varieties, this disease has latterly been of little importance. Mosaic still makes its presence felt in certain areas, particularly in the north coast, and where practicable resistant varieties should be grown in order to control it. Dwarf disease, which gave us a scare some six or seven years ago, has almost faded out of the picture. This disease has an extraordinarily great stunting effect upon P.O.J. 2714 and looked as though it might wipe this variety out; however, it has remained confined to a small low-lying area around Rosella, and, with reduced plantings of P.O.J. 2714, is now hard to find even there.

The one disease which causes us apprehension in this district at present is downy mildew. Downy mildew has been in the district for years and has not done much damage, except when it invaded fields of B.208. To-day, however, there are widespread plantings of P.O.J. 213, P.O.J. 2714 and P.O.J. 2878, and the presence of large areas of these susceptible canes changes the outlook considerably. These three canes are good growers, but if you wish to retain them you must exercise care in the future. I presume that most of you know the symptoms of downy mildew, but in every case it will be as well for you to refresh your memories by examining the specimens exhibited here to-day.

Downey mildew spreads from plant to plant chiefly during the wet season, infection taking place through the eyes or buds of the cane stalk. There is very little spread during the dry months of winter and spring and consequently every effort should be made to inspect fields of young plant cane and ratoon cane at this time and dig out any diseased stools. I have mentioned that infection takes place through the buds and most of the buds on a stalk may be infected although the top still appears quite healthy. Consequently, it is impossible to select healthy plants from among diseased stools, and we strongly recommend that no plants should be taken from within 200 yards of even a single diseased stool.

When a field is badly diseased the trash should be burnt and the field ploughed out after cutting.

Before leaving the subject of downy mildew, it should be mentioned that one P.O.J. cane—P.O.J. 2725—is quite resistant to this disease. It is also resistant to mosaic and top rot, and has the further virtue of having a vigorous rooting system; the variety has not been received with enthusiasm in this district, but its disease and pest resistance entitle it to your consideration.

Turning now to the pest situation. You have been inflicted with one of the worst years on record in respect of grub damage, and we anticipate that it will also be a bad wireworm year. Doubtless many of you will have questions regarding pests on which you desire information; Mr. McDougall, the entomologist attached to the station, is here to-day and will be pleased to discuss any time during the afternoon any points concerning pest control which you care to raise.

Undoubtedly grub damage is very widespread this year and may be found in many farms where most of us have never seen grub damage before. This comparatively heavy damage has been brought about mainly by two factors (1) climatic conditions suitable for the emergence of large numbers of beetles and for the survival of large numbers of grubs and (2) the excessively dry conditions which have prevailed throughout this autumn. Unquestionably much of the damage would not have occurred if April and May rainfall had been normal. During a recent examination of some " grubby " 1900 Seedling, Mr. McDougall found that there was an average of only *one* greyback grub per stool. Although normally the plant could easily withstand the attack of one or two grubs per stool, under present conditions where soil moisture is so scarce, even partial damage to the root system is enough to distress the plant.

The stronger the rooting system of a variety the more grubs per stool can it withstand without showing distress or falling out of the ground. Of course, no variety on earth could withstand an average of, say, 10 grubs per stool, but a choice of suitable resistant varieties will enable escape from serious damage during normal seasons. A good deal has been achieved in this direction by the use of the stronger rooting P.O.J. canes mentioned earlier, but without doubt they could be used further with advantage. (In this connection our remarks regarding susceptibility to downy mildew should be borne in mind, together with the fact that P.O.J. 2725 is resistant to this disease.)

The grub problem in the Mackay area is a difficult one. In ordinary years damage is not very widespread, and in those areas where it does occur every year it is usually patchy in the field. This is, of course, a contrast to the far north, where, if fumigation were not carried out, large areas would be eaten out year after year. In the districts north of Cardwell extensive organisation and equipment has been built up to deal with this annually recurrent pest. We do not believe that Mackay farmers would be justified in following their example for these reasons:—(1) Grub damage is usually patchy in a field, and consequently very extensive pre-fumigation diggings would be necessary to determine where to fumigate; (2) beetles do not emerge in one or two well-defined flights as in North Queensland, but fly over a comparatively long period, and so the grubs do not all concentrate under the stools within a sufficiently short period to ensure success of fumigation; (3) a considerable amount of the usually grub-infested country of Mackay is stoney, and this

would make the use of injectors somewhat difficult; (4) fumigation should be controlled by an experienced supervisor, and a considerable stock of injectors and fumigant must be maintained; it is very doubtful whether the more normal magnitude of the damage in Mackay would ever warrant this.

It is all a question of pounds, shillings, and pence; it is no good expending £100 per year to deal with a pest which, over a ten-year period, causes an average loss of £50 per year. Collection of beetles has been abandoned by the far northern farmers, and we believe that it is uneconomic—certainly the collection of beetles in Mackay last year does not seem to have done much good this season.

We submit that this has been a most abnormal year climatically, and a return to a normal season will soon reduce the grubs to their ordinary numbers. We suggest further planting of strong rooting varieties as being likely to take care of most of the trouble in all but the most abnormal seasons. Finally we are distributing colonies of the Giant American Toad in the hope that this ugly immigrant might assist in reducing grub populations. There are also possible adjustments of grub damaged cane as between No. 1 and No. 2 pools which might receive your attention.

The next most important pest this year, and usually the most important pest of this district, is the wireworm. And here I must emphasise that when we speak of the "wireworm" in this district we mean *Lacon variabilis*, the wireworm found in low-lying, badly-drained fields. There are other kinds of wireworms which may be found in elevated and well-drained lands, but they are not serious pests, although they are often credited with damage which they have not caused.

A great deal of work has been done on wireworm problems all over the world, and a great deal of work was done by Mr. McDougall on this low land wireworm problem of the Mackay area. His investigation showed, and the experience of a number of farmers has proved, that the only permanent means of control is the provision of adequate drainage in a field *before the commencement of the rainy season*. That is to say, if you wish *next* year to plant a block which is subject to wireworm damage, then you must start in and complete the drainage before the end of *this* year. It is no use waiting until next April or May before you start bedding up and draining. The necessity for this pre-rainy season drainage is due to the fact that in its early stages the young wireworm requires extremely wet soil conditions in order to survive, although later on in life it can withstand very dry conditions. Therefore there must be early provision of drainage, so that these very wet conditions will not occur during January-March, and the young wireworms will die out.

The wet season this year was such that in fields where adequate drainage was not provided before the wet season, wireworms are likely to be plentiful. Therefore in those fields, or parts of fields, where wireworm damage is liable to occur, we would recommend that planting be postponed at least until late September. If planting is carried out and the field is eaten out it is little use supplying or replanting until late September at the earliest.

Mr. McDougall has written an article on wireworms for inclusion in the July number of the Quarterly Bulletin, and I would urge all interested to study this closely.

TOUR OF THE STATION.

Mr. McBryde first drew attention to a small block of land which had been graded for flood irrigation purposes and planted to lucerne in order to test the possibilities of this valuable fodder under Mackay conditions.

Across the main roadway was situated a fertilizer trial, the variety being Q. 813, first ratoon. This trial showed the necessity for complete balanced fertilizer applications on this land. To the rear of the laboratory were seen new concrete tables recently made and set up for the reception of the potted cane seedlings which would be planted out from the germination flats two months later. A varietal trial containing some selected seedlings raised at Mackay was inspected; unfortunately, the most vigorous seedling had proved unduly susceptible to downy mildew and would have to be discarded. One seedling, Q. 20, would be released for farm trial plantings in the Spring; this was not a vigorous cane but had high sugar content, was early maturing, and would be tried out on some of the better class lands. About 8,000 original seedlings planted in 1936 were observed; these represented a number of combinations of different parents, and the diversity among the progeny caused considerable interest.

Nearby was a block recently planted to several legumes, some of which may prove of value to the district. They were laid down in such a way as to make irrigation practicable. The species represented are seven varieties of soybeans, berseem clover, and lespedeza or Japanese clover. It was explained that berseem clover resembled lucerne, but was more rank in growth. All the species planted were acid-tolerant and were recommended for poor soils. They, therefore, were promising from the point of view of fodder crops and soil renovators.

While an inspection was made of four non-experimental plots of ratoon Q. 813 and P.O.J. 2725 canes, Mr. McBryde traced the difficulties that had been experienced in regard to effective drainage of the plots. He related that in May, 1935, after the move was made to the new site, it was essential that some cane be planted without delay. The land, which was a wilderness of weeds, was cleared and ploughed, and 4 acres planted without proper bedding. Great difficulty had been experienced with water lying on the ground in lagoons on account of the cultivation practised. Subsequently the land had been graded to some extent and water furrows laid. This was a great improvement. In the second year the land had been subdivided into several sets of a few rows each, and bedded, resulting in further improvement. This year the soil was being scooped and graded, but further grading would still have to be carried out before the plot was entirely satisfactory. As a result of the general drainage system employed, there had been a 150 per cent. increase in escape across Nebo road for the water. The road previously had acted as a dam.

Coming to a large block of mixed land, Mr. McBryde explained that this was one of the poorest and wettest blocks on the property. It was 16 acres in area, and had been subdivided into eight plots. One plot would be planted annually, and one ratoon crop grown. The land therefore would produce two crops of cane in eight years, and during the balance of the period would lie in fallow. It was proposed to test out various grasses and legumes during this period, and the project would be combined with grazing. As a result of wireworm infestation

it was found necessary to delay planting until October, when test setts gave negative results. The strike was good, and although the young crop suffered a great deal from top rot, it had since made satisfactory progress. The second plot would be planted in the Spring, after careful grading and bedding had been carried out.

Four of the plots, comprising 8 acres in all, Mr. McBryde added, were being grazed to sheep, under the Bureau's fat lamb raising project. Grasses were natural panicum and guinea grass. The flock, which obviously was in fine condition, comprised twenty-five ewes of Merino-Corriedale cross, and they were running with a Romney Marsh ram. During the wet season the sheep had shown no signs of ailment, and the growth of the pasture was so rapid that the sheep could not cope with it, and it had to be mowed.

The two remaining two-acre plots in the block had been harvested of natural grasses for horsefeed, and shortly would be opened up for sheep.

An adjoining block, 12 acres in area, would be subdivided, one-half being planted in the Spring, and the balance further graded, bedded, and drained prior to the 1938 planting. This block in the past had been highly susceptible to wireworm damage, due to poor drainage, and this would have to be improved substantially before success could be achieved.

After the field inspection, the gathering returned to the laboratory, where Mr. McDougall exhibited specimens of house, field and khaki rats, also a number of bottled varieties of wireworms. These created considerable interest and numerous questions were asked about each. In a netted box, on an adjoining table, were half a dozen giant American toads which had been brought from the North. Mr. McDougall stated that a large number of small toads had been liberated in Mackay district to try their effect on beetles and grubs.

Demonstrations were given by Mr. McBryde of a small fibrator plant kept for determining relative fibres in cane, and also a small mill used in the determination of c.c.s. values.

During the afternoon demonstrations under actual working conditions were given of a power grubber for new land, and also a weed-removing light harrow, known as a "Cotton Spider," manufactured and patented by a Tully farmer.

Sugar Cane in New Guinea.

By A. F. Bell.

WE have recently been favoured with a visit from Mr. W. M. Pestell, of the Department of Agriculture, in the Mandated Territory of New Guinea, and it is thought that some of his remarks may be of more than passing interest to Queensland canegrowers. The opinion is held by botanists that sugar cane probably originated in two parts of the world, namely in India and New Guinea. The Indian canes are of the thin, hard type and are low in sugar content; New Guinea canes are of varied type, but heretofore interest has centred on the so-called "noble" type of which Badila, the Gorus and Mahona, are well-known representatives. Indeed the early collectors of cane varieties in New

Guinea collected only the noble types of cane or, in other words, collected only those varieties which gave promise of immediate commercial value. In more recent years, with the expansion of cane breeding activities, attention has been also directed towards the " wild " low sugar types with a view to incorporating some of their vigour and hardiness in seedling canes.

Mr. Pestell is strongly of the opinion that much of the Mandated Territory of New Guinea is still unexplored from the cane variety standpoint and especially does he consider this to be so in the case of the so-called " uncontrolled " areas. This " uncontrolled " territory lies inland on the island of New Guinea and extends from the borders of Dutch New Guinea and Papua down to a line which runs roughly parallel to, and about 50 miles from, the coast. It therefore consists mainly of elevated land, rising from a height of about 600 feet above sea level to culminate in the 13,000 feet of Mount Hagon. Owing to this great range in elevation there is inevitably a great variation in climatic conditions. Sugar cane of various types is widely distributed, growing both naturally and under cultivation, and in places has been observed by Mr. Pestell growing at the astounding elevation of 10,000 feet.

Due, doubtless in part, to the cooler climate, the natives of the elevated lands appear to relish the energy-producing sugar, and they are more agriculturally inclined than the coastal natives; consequently, sugar cane is much more widely cultivated by them than by the natives on the coastal belt. For this reason, and the fact that hitherto " closed " territory is being made accessible, together with the development of aerial transport facilities, it is considered that these elevated lands offer a very promising field for cane collectors. Cane is found growing extensively on other islands, notably New Britain, and also on the coastal region of the island of New Guinea.

The cane is cultivated along with other crops in communal gardens by the natives, each village having one to several gardens situated in its vicinity. A village of 100 people may have some 15-20 acres under general cultivation, cane being a major crop at the higher elevations. The land is cultivated only for a period of 1-2 years and then a new site is selected. No irrigation is practised but the rainfall is well distributed, there being no distinct dry season. Varieties are collected during friendly visits or by raiding parties to neighbouring villages. As a rule the cane is planted in the form of setts but occasionally rooted plants are removed. Plants are not placed in furrows but have the earth heaped up in mounds above them; planting is generally done in an irregular fashion, but in some localities in the interior the stools are set out in rows and the fields squared up. Varieties may be mixed but on the other hand a village may grow only a single variety. Planting is carried out at any time of the year and is usually associated with ceremonial observances designed to propitiate the spirits and ensure the success of the crop.

The natives select the varieties to be grown mainly on their suitability for chewing and consequently there is a tendency to select low fibred canes which frequently have to be supported by bamboo frames. In this connection it is interesting to note that Badila is regarded as a comparatively high fibred cane! Dried strips of cane rind are used to line the native houses; the cane is split open, pressed under stones, the dried flesh pulled off, and the strips of rind then woven to form a

coarse mat. The dried tops are used for bedding. In addition to chewing-cane, the " wild " type of cane is grown as a green vegetable, the young tops being cooked and eaten.

At least three types of cane have been observed; the well-known noble (Badila type) cane, the " wild " cane (thin, hardy and low in sugar) and the " robustum " type, a tall vigorous type which was first observed by the Brandes expedition in 1928. The robustum type is cultivated to some extent but also grows prolifically in the natural state, especially along the rivers. There also appear to be many hybrids and it is of great interest to note that two plants, identified at Kew as being cane-sorghum hybrids, were found growing naturally near Kaiapit, on the Upper Markham River, at an elevation of some 1,300 feet. Naturally growing canes may occupy considerable areas in some places and tracts of some 20-30 acres of an almost pure stand of sugar cane may be observed at times.

Arrowing is generally prolific, and is not confined to a restricted period as in Australia, but varies according to locality and elevation. Arrowing is apparently regarded by the natives as a symbol of maturity, as they frequently will not harvest the cane until it has arrowed.

No comprehensive pathological survey of sugar cane in New Guinea has ever been carried out, but Fiji disease and mosaic have been observed in many localities, the latter being most common in the very wet southern coastal districts of New Britain. Doubtless further surveys would reveal the presence of many more diseases of cane.

It is of more than passing interest to the cane breeder to reflect that these two diseases, and especially Fiji disease, have coexisted with sugar cane in New Guinea down through the ages without gaining the upper hand. It is obvious that in those regions of New Guinea where Fiji disease occurs, the indigenous canes must have very considerable resistance to the disease—otherwise they would have been wiped out ages ago. Now Fiji disease is of great potential importance in Queensland, and especially in Southern Queensland. It is very desirable and, indeed, necessary that the vigour of the noble canes be improved by crossing back to the wild hardy types, and we can see some of the results and possibilities of this procedure in the new P.O.J. canes, which are descended from a wild cane of the Dutch East Indies. Unfortunately, the introduction of this particular strain of wild blood also confers great susceptibility to Fiji disease (and other diseases). It would appear logical, then, that other strains of wild canes should be sought for breeding purposes in regions where long association with Fiji disease has ensured their resistance to it. What applies to Fiji disease may also well apply to other diseases, such as downy mildew. It would therefore appear that the Queensland Sugar Industry, which already owes much to New Guinea, may well profit further by availing itself of the wealth of cane-breeding material still available in that neighbouring but yet largely unexplored island.

Intensive Cane Production.

By H. W. Kerr.

IT will be recalled that four years ago we commenced a small scale irrigation trial at the Bundaberg station, to demonstrate what could be grown on the red volcanic soils of Bundaberg, when soil moisture and fertility ceased to be limiting factors. The new variety P.O.J. 2878 was planted in the experimental area, and the crop was liberally fertilized and watered throughout its growth period.

We have now the results of three crops—plant, first and second ratoons. The aggregate yield per acre of cane and sugar are as follows:—

Total cane yield per acre (3 crops) .. **233 tons.**
Total sugar yield per acre (3 crops) .. **28 tons.**

These yields are far in excess of the Queensland average, and demonstrate still further the extreme value of irrigation as an aid in cane production, particularly where deep fertile soils are available in areas of light and erratic rainfall.

The benefits of the practice have been so vividly proven to growers in the Southern districts that in all mill areas, it is pleasing to note, many growers are attempting to turn all available water resources to good account. Unfortunately, the frequency with which suitable local supplies are encountered is far from high, and in most cases, collective action would be necessary to finance the cost of a scheme designed to effect wider utilization of natural streams.

We have also been able to demonstrate that the fears of serious over-production of cane, due to the adoption of intensive production methods, need have no foundation; growers could reduce their cane acreages proportionately to their tonnage-per-acre increases, and devote the land thus liberated to the production of alternative crops, the growth of which, under irrigation, could also be made worth while. Care in the choice of the supplementary crop selected would also assume the production of those commodities for which a ready market exists.

Sooty Mould on Sugar Cane in the Babinda District.

During the past two years we have received a considerable number of reports from farmers in the Babinda area that their cane is being badly damaged by sooty mould. The symptoms of this so-called disease are probably familiar to most farmers; during dry weather the leaves, especially lower leaves, become covered with a black sooty deposit, causing the plants to present a dirty sick appearance; it will also be observed that this sooty deposit is worst in patches where the cane is stunted. Actually the cane is not diseased, in the strict sense of the word, although it is not claimed that no stunting results from the "suffocation" of the cane leaves by this sooty deposit.

On turning back the leaves of cane, especially stunted cane, growers may frequently observe colonies of a dirty yellowish aphid on the lower surface of the older leaves. This aphid is known as the cane aphid

(*Aphis sacchari*) and as it feeds it secretes a sweet honey dew. The spores or "seeds" of a particular fungus fall on the leaves and germinate and grow in this rich, sweet honey dew without actually penetrating the cane leaf at all. The sooty coating may be rubbed off the leaf with the finger; it is exactly similar to the sooty mould which is so common on the leaves of citrus trees in North Queensland.

The cane aphid thrives during dry weather, and consequently with the advent of a long dry spell, the sooty mould also makes its appearance. On the other hand wet conditions very rapidly kill off the aphid population and the sooty mould disappears again.

Normally, cane aphids are found in appreciable numbers only on the lower older leaves of the cane, and hence the sooty mould which follows them can do little or no harm. However, during prolonged dry spells, and where the cane is already sickly and stunted, the aphid will be found feeding on quite young leaves, and so we soon get the appearance of the sooty mould on such leaves also. Although the sooty mould fungus does not attack the plant directly it seems obvious that it must cover up the leaf pores and cause still further stunting. That is to say the sooty mould does not start the cane on the downward path but does "kick it when it is down."

It will be seen then that to avoid the effects of sooty mould it is necessary to rectify the cause of the stunting in the first place. During the past season several inspections have been made by members of the Division of Entomology and Pathology—and they have found that sooty mould is definitely worst on the low lands, and particularly so in local badly drained depressions. Although present the disease was very much less marked on the elevated red soils. The chief factors causing the initial stunting on the low-lying areas appear to be 1, inadequate drainage; 2, low fertility or high acidity; 3, chlorotic streak disease. The provision of adequate drainage needs no elaboration and the field officers of the Bureau are at the service of farmers for the purpose of taking soil samples for the determining of the correct fertilizer to be used or amounts of lime per acre required. Chlorotic streak is a disease which has been observed in Java, Hawaii, Puerto Rico and Australia, but its cause still remains obscure. Experiments have shown us that it spreads fairly rapidly in the low-lying areas of the heavy rainfall districts of Queensland, but that it spreads very slowly, if at all, in elevated fields. If diseased cane is planted in a field on a red volcanic hillside, for example, the resultant plants will be diseased, but the disease does not spread into the adjacent healthy cane. Consequently, it follows that in the Babinda area it is bad practice to take cane plants from the river flats up to the hills but, on the contrary, it would help the control of this disease very considerably if the flats could be planted with selected cane from the hills. We say selected cane advisedly, since there is chlorotic streak disease in hillside fields which have been planted with diseased cane. The symptoms of chlorotic streak disease are only visible in young cane and consequently cane which is to be used for plants in the autumn or spring of 1938 should be selected round about November-December of this year. Such inspections and the keeping of records as to the suitability of individual blocks for plants would require the services of a resident field officer which, unfortunately, the district does not possess. Healthy cane when planted on the flats will definitely contract this disease but the planting of healthy plants enables it to

get off to a good start, and experiments carried out by the Bureau have indicated that a nett gain of some 25 per cent. may be expected in both plant and ratoon crops.

Two chlorotic streak-sooty mould resistance trials with over twenty varieties have been planted in the Babinda area this year, and their progress will be watched with interest.

A.F.B.

A New Trash Plough.

By N. J. King.

IN the Canegrowers' Quarterly Bulletin of October 1st, 1935, was printed a short note regarding a new trash-cutting device. This attachment has been considerably improved since that time and has now reached a stage where the experimental period has practically passed. No doubt some minor improvements will still be made, but up to date the plough has made an excellent job of covering some heavy crops of trash.

Fig. 23.—New trash plough: position and drive of cutting wheel.

The land wheel of the plough acts as the driving wheel for the cutter. By means of a chain drive and a counter-shaft from the land wheel a second chain drives the cutting wheel at a considerable speed. The cutting wheel, on which the knives are curved, takes the trash against a stationary blade, thus cutting off a length of trash equal to the width of the plough-cut. A shoe runs along the surface of the ground, lifting the trash and guiding it to the revolving cutter. To avoid inequalities in the surface making the shoe dig into the soil the

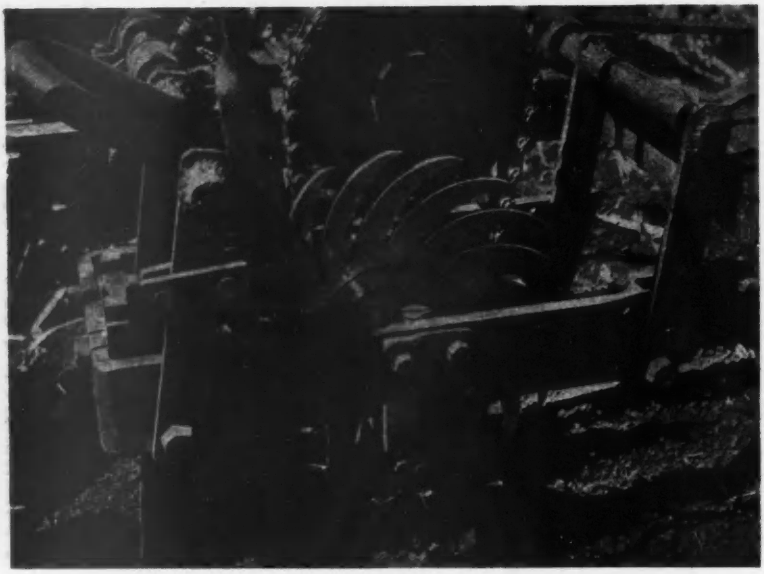

Fig. 24.—New trash plough: detail of cutting wheel.

Fig. 25.—Illustrating the work of the new trash plough; left: trash covered unploughed land; centre: trash ploughed in with trash plough; right: trash ploughed in with single disc plough.

entire cutting device and shoe are swung on two shafts. Should the shoe strike a rise or some high stubble the entire arrangement swings back and up, still cutting the trash, and returns to the normal level when the obstruction is passed.

The photographs illustrate the plough and the cutting device. Fig. 25 shows the type of work done; on the right is the result of ploughing in the trash with a single disc plough, while in the centre is shown the result of the trash plough, and on the left the unploughed, trash-covered ground. Dead sticks did not interfere with the cutter. The outstanding advantage of turning in the trash with such a plough is that the trash is directed after cutting into the bottom of the furrow by means of a small mould-board. The cover of soil then covers the trash to a depth depending on the depth being ploughed. In the above case eight inches of soil covered the trash. An ideal seed bed for a green manure crop is thus obtained, and the trash is not mixed up with the soil as is often the case, providing air spaces and allowing rapid drying out. The trash plough illustrated is the invention of a Bundaberg farmer, and undoubtedly promises to overcome the long-felt need for an implement capable of dealing with this difficult material.

Seedling Hothouse at Bundaberg Station.

The erection of a new hothouse for the propagation of cane seedlings has just been completed at the Bundaberg Station. The house is heated by a hot water pipe system, during cold nights, while the warm humid atmosphere which is maintained throughout the daytime, provides those conditions which make for speedy germination of seed, and rapid growth of the young plants.

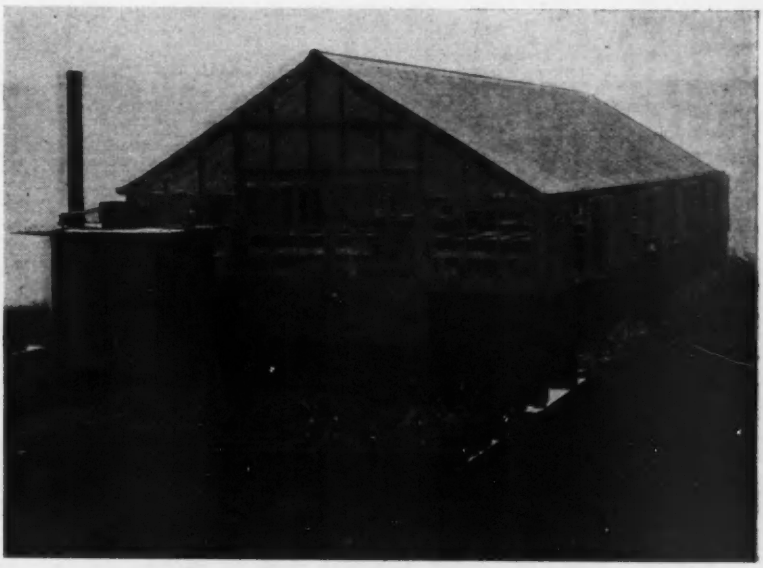

Fig. 26.—New seedling hothouse, Bundaberg Station.

In the construction of the house, free use has been made of a modern material which has been used successfully elsewhere as a glass substitute. It consists of a cellulose preparation, reinforced by stainless wire gauze, which is highly translucent, and allows free passage of the light rays most active in growth promotion. This material makes for economy in that it is cheaper than glass, both in purchase price and fixing costs, and it is, in addition, hail proof.

In front of the hothouse will be seen the concrete seedling benches on which the potted seedlings are grown. They are set out in a double row, between which runs a tramline, so that the seedlings, in flats or pots, may be transported expeditiously.

N.J.K.

David Whyte, Government Printer, Brisbane